

I have an "Ecology Now" sticker on a car that drips oil everywhere it's parked.

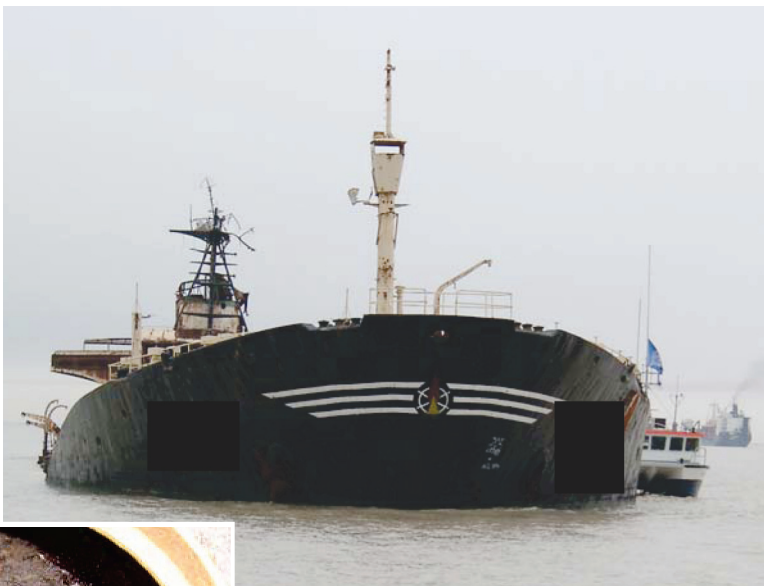
Mark Sagoff

Earth Ethics (Summer 1990)

WARFARE

Iraq's Toxic Shipwrecks

Iraq's coastline consists of a 36-mile stretch along the north end of the Persian Gulf. The country has only two deep-water ports, Umm Qasr and Az Zubayr. Three wars—the Iran–Iraq War from 1980 to 1988, the 1991 Gulf War, and the U.S. invasion of Iraq in 2003—have cluttered northern gulf waters with a welter of sunken ships, many of which still hold petroleum products, unexploded ordnance, and possibly rocket fuel, propellants, and toxic chemicals. Many of the ships are leaking. Little is known about the environmental health consequences of these marine obstacles and their contents, but a recent report by the United Nations Development Programme (UNDP) looks at the potential environmental hazards posed by the sunken ships.



In preparing *Iraqi Waterway Project Wreck Removal: Environmental Damage Limitation Survey*, published in October 2004, a UNDP team assisted by International Atomic Energy Agency marine experts and two French water pollution agencies inspected 40 wrecks, identified 12 more by sonar, and collected 198 sediment samples for analysis. The team estimates that more than 260 sunken ships—including tankers, tugs, barges, and patrol boats—clog the local waters. "Virtually all of these vessels are slowly leaking substances that are damaging to marine life and people alike," states the report. "Even if the vessel was not

carrying a hazardous cargo, the engine room will typically contain substances such as fuel oil, lubricating oil, battery acid, hydraulic fluid, and asbestos."

Silting is a major problem in Iraqi ports, as with most harbors. But dredging cannot proceed safely or commerce resume fully until more of the wrecks have been cleared away—a process made complex and dangerous by the possibility of ordnance detonation and the turbidity produced by the strong gulf current. The current flows counterclockwise

anemia, and leukemia, according to the Agency for Toxic Substances and Disease Registry (ATSDR), and is classified as a known carcinogen by the National Toxicology Program. Depending on the exposure pathway, fuel oils can cause nausea, loss of appetite, poor coordination, kidney damage, heightened blood pressure, and other problems, according to the ATSDR.

Heavy metals were generally found in relatively small quantities, although one sediment sample from inside a wreck did contain elevated lead levels. Radioactivity was consistent with natural distribution of uranium in the Earth's crust. The survey found low concentrations of polycyclic aromatic hydrocarbons and no evidence of organochlorines such as polychlorinated biphenyls or DDT. The report also cites a 1994 UK government letter to the Security Council expressing concern that Iraqi patrol boats and hovercraft sunk in the first Gulf War may have carried chemical weapons canisters which could begin to leak.

The UNDP survey was part of a series of projects to clean up Iraqi waters and bring the ports to full capacity. Before the report was issued, 31

Sea assault. The Persian Gulf is being polluted by numerous toxic shipwrecks, such as this tanker containing 5,000 metric tons of heavy crude oil as well as three live artillery rounds that helped sink it.

wrecks had already been removed, according to Michel Gautier, UNDP–Iraq infrastructure manager. The UNDP proposes to continue wreck removal activities, and collection and treatment of the remaining oil in the wrecks in both Iraqi and adjoining Kuwaiti waters, with the focus on identifying and removing the most obstructive and dangerous wrecks.

toward Kuwait, and it may carry pollution toward Kuwaiti desalination plants along the Persian Gulf coast. Approximately 70–90% of the people in the gulf region get their fresh water from desalination plants, according to *The Economic and Environmental Impact of the Gulf War on Kuwait and the Persian Gulf*. This report appears in the Trade and the Environment Database, a project of American University in Washington, D.C.

The UNDP found that oil is the worst problem related to the sunken ships, stating that "significant oil pollution was painfully evident even without any sample analysis." Much of the oil is crude, bunker, and diesel grades. Such oils contain many hydrocarbon compounds, including benzene, propane, acetylene, naphtha, and kerosene, all of which can cause health effects. Benzene, for example, can cause dizziness, tremors,

The Persian Gulf isn't the only place threatened by toxic wrecks. A 22 January 2005 article in *New Scientist* reported that the U.S. liberty ship *Richard Montgomery*, scuttled in the Thames during World War II, might release and detonate its payload of TNT in the next 20 years. And a 2001 cyclone plastered the Micronesian atoll of Ulithi with oil and gasoline from the U.S.S. *Mississinewa*, sunk during World War II and estimated to still contain 36 million liters of oil, according to the Vanuatu news organization Port Vila Presse. —Valerie J. Brown

TRANSPORTATION/FUELS

Souped-Up Yeast

The high cost of oil makes ethanol and other alternative fuels increasingly attractive. Proponents of ethanol point to corn, wheat, and other food crops as renewable feedstocks for producing the fuel. However, critics contend that diverting food crops for ethanol production is economically unsound, and that the irrigation, pesticides, and diesel fuel used to produce these crops poses an environmental burden. A new solution converts agricultural waste such as cornstalks and wheat straw into ethanol. Molecular biologist Nancy Ho of Purdue University's Laboratory of Renewable Resources Engineering spent 20 years perfecting the method, which has been nonexclusively licensed to Canadian enzyme manufacturer Iogen to make ethanol in an environmentally friendly plant.

Ethanol is produced through fermentation of the glucose found in plant matter. The yeast *Saccharomyces*—used for centuries to make wine, beer, and bread—is the most efficient microorganism for fermenting glucose to ethanol. Food crops such as corn and wheat are especially suitable for ethanol production because the glucose in their kernels is readily fermentable by *Saccharomyces*. In contrast, the cellulose found in cornstalks and other types of cellulosic biomass contains not only glucose, but also the sugar xylose, which *Saccharomyces* cannot convert to ethanol because it lacks the enzymes to do so.

Glucose and xylose can be fermented separately, but it's a costly process. Some manufacturers do convert just the glucose in waste feedstocks to ethanol, but production is very low. If the xylose fermentation hurdle could be overcome, the waste material left in the cornfield after harvest could produce 4–5 billion gallons of ethanol annually, says Ho.

Ho's solution was to create a genetically modified strain of *Saccharomyces* that simultaneously ferments both glucose and xylose to ethanol. Some bacteria contain the enzyme xylose isomerase, which ferments xylose to ethanol in one step. In the 1980s, Ho first cloned and inserted a bacterial gene

for xylose isomerase into *Saccharomyces*, only to discover that the enzyme did not function inside the yeast. Her second approach proved successful, but required several enzymes and complex steps—in short, Ho cloned three genes from another yeast and inserted them into *Saccharomyces*. They act in a pathway to convert xylose into xylitol, xylulose, and xylulose-5-phosphate, before eventually producing ethanol. Ho also tinkered with the enzymes to make them operate faster. This work is described in the spring 2004 issue of *Applied Biochemistry and Biotechnology*.

The novel method raises the yield of ethanol by 40%, compared to fermenting only the glucose in cornstalks and related materials. One of the resulting recombinant yeasts, named 424A(LNH-ST), is now being used by the Ottawa-based Iogen to produce ethanol using wheat straw obtained from nearby farms. The fuel is sold under the trade name EcoEthanol™.

Iogen had tried recombinant yeasts and bacteria designed by other scientists, but they performed poorly when scaled up for industrial production. "The Purdue yeast is the best we've tested," says chemical engineer Jeff Tolan, Iogen's manager of process research and development. "The Purdue yeast is as easy to work with as making bread at home." Although the Iogen plant has used only wheat straw as a feedstock, the Purdue yeast could efficiently convert xylose from cornstalks, wood chips, and cardboard to ethanol in their processing facility.

The Iogen plant makes about 75 gallons of ethanol per ton of straw. About two-thirds of the straw is fermented to ethanol. The remainder, which is primarily lignin, is burned for fuel at a local pulp mill. For a full-scale ethanol plant, the lignin could be used to generate power for the plant. "A full-scale plant could be run without any net burning of fossil fuel," says Tolan. In addition, EcoEthanol reduces the net generation of greenhouse gases, because the plants being grown for feedstock recycle the carbon dioxide released into the atmosphere when the fuel is burned. Iogen plans to build a full-scale commercial facility that will produce 50 million gallons of EcoEthanol yearly. —Carol Potera



Pump up the volume. A novel method increases the amount of ethanol that can be derived from agricultural waste.

Vive la Petite Auto!

Starting in January 2005 French drivers who buy large vehicles must pay a surcharge of up to about US\$4,700 as part of a plan drawn up by the French Environment Ministry. The plan also rewards purchasers of smaller, cleaner vehicles with a rebate of up to US\$935; the revenue from the sale of the 350,000 large vehicles typically sold each year is expected to pay for the small car rebates. This plan follows a yet-to-be-passed



resolution to restrict SUVs in Paris's city center and tourist areas. A recent study by the French government found that some 7% of premature deaths from lung cancer and cardiovascular and respiratory problems in France could be directly linked to vehicle emissions.

China Goes Retro

In Beijing alone, nearly 1,000 new vehicles hit the road each day, and several Chinese metropolises (including Beijing) are among the world's most polluted cities. Now a U.S.–Chinese partnership aims to turn the tide. In November 2004 the U.S. EPA, China's State Environmental Protection Administration, the Beijing Environmental Protection Bureau, and other groups began a demonstration plan to retrofit an existing Chinese fleet of buses and trucks with clean diesel technology. The EPA has pledged \$250,000 and a significant number of man-hours to the effort. Emissions from older diesel vehicles pose serious health problems and contribute to acid rain and ozone formation. Retrofitting should reduce emissions in the test diesel fleet by 40% or more.

Green Journalism in Mozambique

The Mozambican Grupo Ambiental de Jornalistas, with assistance from the Blacksmith Institute, has begun producing and broadcasting environmental health programs on Radio Mozambique's two main channels. Topics to date have included the causes and prevention of cholera (an intractable problem for the country for the past 15 years), the potential impact on crops and wildlife of the Cahora Bassa hydroelectric dam now under construction, benefits of unleaded gasoline (Mozambique is currently phasing out leaded gas), the need to conserve water, and tips for general sanitation. The group hopes to give the general public a sense of how their environment affects their health, and to promote discussion and environmental health advocacy.



FOOD SAFETY

Perchlorate Exposure: Tip of the Iceberg?

For several years, federal and state agencies have debated over what is an acceptable level of human perchlorate exposure through food and drinking water. Now Food and Drug Administration (FDA) investigators have found the chemical in milk and lettuce from 15 states, including some apparently uncontaminated areas, showing that human exposure may come from more sources than expected.

Perchlorate is used mainly in rocket fuel as well as in some fertilizers and explosives. Perchlorate with no anthropogenic source has been found at 20–60 parts per billion (ppb) in West Texas groundwater and in trace amounts in precipitation, says Texas Tech University chemist Purnendu Dasgupta. This suggests atmospheric reactions may create a low background level of perchlorate. Perchlorate disrupts thyroid function by competitively inhibiting iodine uptake in a dose-dependent fashion, with unquantified effects in humans.

In a November 2004 agency report, FDA scientists wrote of finding an average 7.76–11.9 ppb perchlorate in about 90% of lettuce samples from Arizona, California, Florida, New Jersey, and Texas. They also found an average of 5.76 ppb in 97% of cow's milk samples collected at stores in 14 states. Until more is known about the health effects of perchlorate and its occurrence in foods, the FDA continues



Salad surprise. Perchlorate has turned up in foods including lettuce samples from five states.

to recommend that people of all ages eat a balanced, healthy diet.

Parts of southern Arizona and California are irrigated with river water containing roughly 4–6 ppb perchlorate, but contamination is not known at the other sites. “The results are surprising—we would have expected lettuce grown in known perchlorate-contaminated areas to have higher concentrations than lettuce from apparently uncontaminated areas,” says Terry Troxell, director of the FDA Office of Plant and Dairy Foods. Troxell says samples with very high and

very low values came from the same place. For example, the highest lettuce concentration was 71.6 ppb in iceberg lettuce from Belle Glade, Florida. But another Belle Glade iceberg sample contained 1.3 ppb.

“I don’t think it’s possible to conclude anything about the national food supply from this survey,” says Kevin Mayer, the Environmental Protection Agency Region 9 perchlorate coordinator. Still, says Bill Walker, West Coast director for the nonprofit Environmental Working Group, “The surprising data suggest that this is a national problem and that risk assessments have to account for dietary exposure.”

In January 2005 the National Academy of Sciences reported that more information is needed on food as a source of perchlorate exposure. Meanwhile, the evidence rolls in. In the 26 January 2005 *Journal of Agricultural and Food Chemistry*, Texas Tech researchers reported finding perchlorate in a variety of forage and edible crops, including alfalfa and cantaloupe. The FDA is also sampling tomatoes, carrots, cantaloupe, and spinach, with results to come. —Rebecca Renner

AGRICULTURE

Disaster-Ready Corn

In the past 15 years, the number of droughts and other weather-related natural disasters worldwide has more than doubled, according to the international nonprofit Future Harvest. So it was welcome news when researchers at the University of California, Riverside, reported in the December 2004 *Plant Journal* what could be a way to improve the drought resistance of maize. Maize is now the most widely produced cereal in the world, having overtaken rice and wheat. Many areas where maize is grown, including parts of Africa, are vulnerable to drought.

Ethylene, a compound produced by plants, is believed to help plants adapt to stress, but can also cause leaves to wither in response to dry conditions. Daniel Gallie and colleagues found that the leaves of reduced-ethylene plants remained green longer than normal plants, and that reducing a plant’s ethylene production postponed withering and maintained leaf function.

Gallie and his colleagues identified transposons that had knocked out the enzyme that starts ethylene production in maize. Transposons are DNA elements that move from one position in the genome to another, knocking out the gene at the new position and replacing it. After screening thousands of plants, they found plants with mutant DNA affecting two of the three genes that make an enzyme needed for ethylene production. After confirming that the knockout mutants indeed produced less ethylene, they multiplied those plants and examined their growth in Riverside’s research fields. Not only did the mutant plants’ leaves stay green longer than normal plants, the plants’ leaves experienced higher-than-normal photosynthesis rates.

It’s still unknown whether the mutation improves the plants’ cereal productivity as well as leaf production, and how reduction of ethylene affects other plant functions. Jerry Cohen, deputy division director for Molecular and Cellular Biosciences at the National Science Foundation, says that in maize, ethylene also encourages rooting and

adaptation to flooding; simply reducing ethylene in maize, he says, “could end up with nice plants lying on the ground.” Still, he adds, this study opens many new possibilities for maize improvement.

Mary Eubanks, a maize researcher at Duke University, notes that by providing better nutrition during drought, hardy maize would help maintain people’s immune systems and make them better able to resist infectious diseases. In the United States (the largest maize producer), hardier plants could reduce irrigation demand and consequent runoff. Irrigation represents more than half of the world’s freshwater demand, yet most of that is lost to evaporation, and runoff can pollute surface and groundwater with agricultural chemicals.

Gallie sees another potential benefit. With climate change, he says, competition between urban and agricultural demands on scarce water resources is likely to intensify. Any crop that uses less water can help ease that conflict. Cohen concurs: “Efficient use of water is the dominant theme of twenty-first century agriculture.” —David A. Taylor

ehpnet

www.fueleconomy.gov

The 2005 North American International Auto Show in Detroit saw the introduction of a number of highly efficient cars, including several new gas-electric hybrid models. The market is expected to see even more hybrid and other alternative models in the future, with U.S. sales of hybrids alone projected to grow from 80,000 in 2004 to more than 400,000 in 2008, according to marketing information firm J.D. Power and Associates. Now the U.S. Department of Energy and Environmental Protection Agency have teamed up to develop a website, <http://www.fueleconomy.gov/>, where consumers can learn more about new automobile technologies and get help in selecting a fuel-efficient vehicle from the models currently on the market.



The site's Why Is Fuel Economy Important? section answers its titular question with information contained in four subsections: Protect the Environment, Reduce Oil Imports, Conserve Resources for Future Generations, and Save Money. The Protect the Environment subsection describes how petroleum extraction and use contributes to global warming, oil spills, and air pollution. Currently 133 million Americans live in areas that fail at least one National Ambient Air Quality Standard, and vehicles produce 25–75% of the chemicals that pollute the air. All new vehicles must meet federal emissions standards, and those that use fuel more efficiently may produce less pollution over time than those with lower fuel economy.

The online *Model Year 2005 Fuel Economy Guide*, which can be downloaded for free, offers a list of the year's best-in-category automobiles as well as a complete categorical listing of the year's models sold in the United States and fuel economy figures for each. The listings include hybrid and other alternative fuel vehicles. By selecting the Find and Compare Cars link, consumers can search an online database by model year, class, make, miles per gallon, and fuel requirements to find a vehicle to meet their personal requirements.

For people looking to learn more about how hybrid and other alternative vehicles work, the Advanced Technology section provides short descriptions of systems and materials incorporated into vehicles to help improve their fuel economy. These include aerodynamic design and lightweight materials such as aluminum, plastics, magnesium, carbon fiber, and metal matrix composites. This section also offers links to outside sites that provide more in-depth information on these technologies.

Looking for cheap gas? Want to know how to improve your fuel economy? The site answers these two questions with separate sections. The Gasoline Prices section provides price information at the local, state, regional, and national level, and allows visitors to find the cheapest gas nearby. The Gas Mileage Tips section provides information on driving more efficiently, keeping cars in shape, planning and combining trips, and choosing more efficient vehicles.

The Answers to Your Questions link on the homepage leads to information on how greenhouse gas emissions are determined, whether to use premium or regular gasoline, how fuel economy estimates are obtained, the gas guzzler tax, and tax incentives for alternative fuel and hybrid vehicles. There is also a Links page that routes visitors to online car buyer guides, electronic magazines and news sites, safety and environmental research sites, advanced technology information, and manufacturer homepages. —Erin E. Dooley

An End to Idle Threats?

Thanks to a new electrified system developed by IdleAire Technologies and currently used at 23 truck stops across the country, truckers can do their job in a cleaner way. Long-haul truckers are required to take a 10-hour rest stop for every 11 hours on the road. During that time, they traditionally keep their diesel engines running to power heaters, televisions, and other amenities inside the cab. Now they can plug into an IdleAire unit to meet a variety of electricity needs.



Idling trucks use about 1 billion gallons of fuel each year. The resulting diesel particles can cause a number of conditions including asthma, lung cancer, and heart disease. Installation of the IdleAire system at just one New Jersey truck stop eliminated 140 tons of pollution and saved 19,000 gallons of diesel fuel in its first six weeks of use.

Defining the Sprawlscape

Yale urbanism and architecture professor Dolores Hayden has written *A Field Guide to Sprawl* to provide urban planners and sustainable-growth advocates with a common language for describing the sprawl landscape. The idea for the guide stemmed from Hayden's difficulty in articulating to her students the new urban configurations often brought about by rapid and unchecked growth. The guide, released in July 2004, contains 51 novel "sprawl species" such as toad (short for "temporary, obsolete, abandoned, or derelict site") and snout houses (homes characterized by prominent full-frontal garages). Hayden amassed the entries after searching industry websites, newspaper columns, real estate manuals, and planning glossaries.

Phone-y Flowers

With 80 million new wireless phones sold in North America each year and the average user upgrading to a new phone every 18 months, the disposal of old phones is a huge problem. The phones not only take up valuable landfill space, but also contain toxic metals such as lead and cadmium that can leach into the environment. Researchers at Britain's University of Warwick working with Motorola and the materials company PVAXX Research and Development have come up with



a way to stem at least part of the problem in a unique way. They have developed a special polymer phone casing with a high-quality finish—and a twist: it's compostable. For a final flourish, the designers embedded flower seeds in the casing, which germinate when the cover is composted.